

MOVEMENT AND FLOCK COMPOSITION OF THE  
GREAT INDIAN BUSTARD *ARDEOTIS NIGRICEPS*  
(VIGORS) AT NANAJ, SOLAPUR DISTRICT,  
MAHARASHTRA, INDIA<sup>1</sup>

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(With two text-figures)

Many animals of the arid zones are nomadic in order to survive the temporal and spatial fluctuations in the food availability in their environment. Food supply, especially for insectivores and herbivores, is generally dependent on precipitation. Numerous workers (e.g. Keast & Marshall 1954, Davies 1968, 1984, Thomas 1984) have shown the correlation between rainfall and movement of birds of the arid areas. The Great Indian Bustard *Ardeotis nigriceps* (Vigors) is a bird of open spaces of scanty grassland interspersed with scrub and cultivation in more or less semi-desert country. It is resident and seasonally nomadic, dispersing widely in the monsoon with the creation of grasslands (Ali & Ripley 1969). The pattern of its local movements have not been studied in detail (Ali 1970).

The Great Indian Bustard (GIB) has become rare [Ripley 1952 (see Editors' comments), Ali 1970, Gupta 1970] but its over-all distributional range has not changed much (Goriup 1980). Due to its rarity and destruction of its habitat, the movements of the GIB have presumably become more erratic. However, with the revival of a few grasslands since

1976 under the Drought-Prone-Areas-Programme (DPAP) in Maharashtra, sightings of the GIB in some rehabilitated areas have become more common especially during the monsoon. The present paper on the local movement and flock composition forms a part of the study of the ecology and behaviour of the Great Indian Bustard. This study is based on unmarked birds, therefore movements outside the study area could not be followed. Daily movements and flock composition of a resident GIB population at Karera (Shivpuri district, Madhya Pradesh) will be dealt with separately.

STUDY AREA AND METHODOLOGY

*Study area:* Nanaj in Solapur district (17° 41'N, 75°56'E, alt. 486 m) in Maharashtra State, India was selected as one of the field stations. The study period extended from August 1981 to December 1984.

Near Nanaj village three small areas which were previously grazing land were taken over by the State Forest Department in 1976 under the DPAP to be developed as pastures and woodlots. Later more plots were added. The terrain of Nanaj is gently undulating, characteristic of the Deccan Plateau. The climate is dry and the maximum temperature varies from 25.5°C in winter to 42.5°C in summer.

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The year can be divided into three seasons : winter (Nov.-Jan.); summer (Feb.-June) and monsoon (July-Oct.). Solapur district is semi-arid (meaning an area with 7-8 months of the year dry and an annual rainfall of less than 750 mm (Bagnols & Gaussen 1957). Average annual precipitation in Solapur is 724 mm. Rainfall is erratic and ill distributed with year to year fluctuations.

**Methodology:** In order to determine the local movement and flock composition of the GIB, a daily record of the following parameters was kept, namely (1) Total number of bustards seen in the study area, (2) Maximum number of birds seen in a flock, (3) Flock composition, (4) Plot(s) where seen, (5) Time, (6) Local weather conditions and, (7) Local movements between plots to record habitat preference. Mother and chick were taken as one unit as they were always seen together. Only post-juvenile chick was noted separately. Birds moving together for hours were considered as a group or a flock. Temporary association while foraging was not noted as a flock. Every week the maximum number of bustards seen on any day, and the maximum number seen in a flock was noted (figs. 1 & 2). Even bustard(s) seen for a day or two in any particular week was included in the histograms. In 1983, for instance, between 25 to 31 December two hens were seen on 26th evening after a slight drizzle, they were not seen the next morning but in Figure 1 C, covering that particular week they are shown as if present throughout the week.

## RESULTS

### *Annual Movement of Bustards*

1981: During a preliminary visit to Nanaj on 29th April, the area was totally dry and

no bird was sighted (fig. 1, A). In the second visit in August, eight bustards (three males and five females) were sighted. The monsoon had already started (fig. 2, A) and the birds were settling to breed. Thereafter, one or two males and four to five females were regularly seen. By the third week of November, the territorial cock was irregularly seen and soon all the females left the area with their respective chicks, except for one late-nester which was seen till mid-December.

1982: No bird was seen from January till April. There were unseasonal showers from mid-April as a result of which grass started growing. Though there was no rain during the next week, the sky was generally overcast. Between 30 April and 6 May, 3.5 mm of rain fell. First two, then three male bustards were seen together and no agonistic behaviour was noted probably because the breeding season had not started.

Due to erratic rains at Nanaj in 1982, and consequently greening and drying of grass alternately, daily bustard movement was also unpredictable. Though the territorial cock was seen more or less throughout the breeding season, non-territorial males and females were not seen daily, or were seen in highly fluctuating numbers (fig. 2, B). Breeding was not recorded (Table 4) and most of the females were seen in twos or threes or occasionally in group-size of six to seven birds (Table 2, B). In October, the females were not seen at all in our study area (Table 2, B) and we presume they had moved in search of more favourable areas for nesting. (In 1983 we saw two juvenile chicks with their respective mothers, which shows that the birds had nested elsewhere).

1983: A few mm of rain fell between 6

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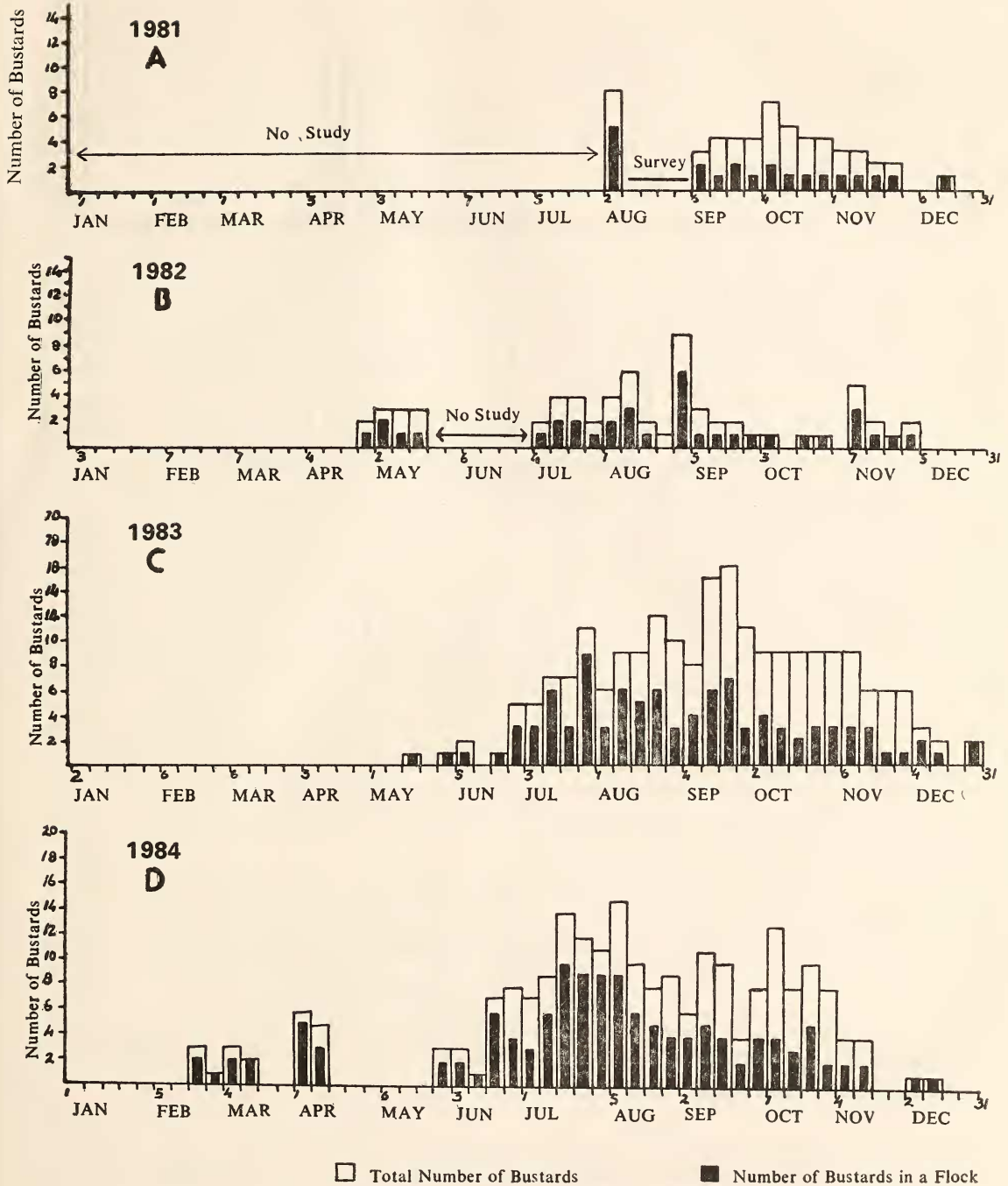


Fig. 1. Movement of bustards at Nanaj.

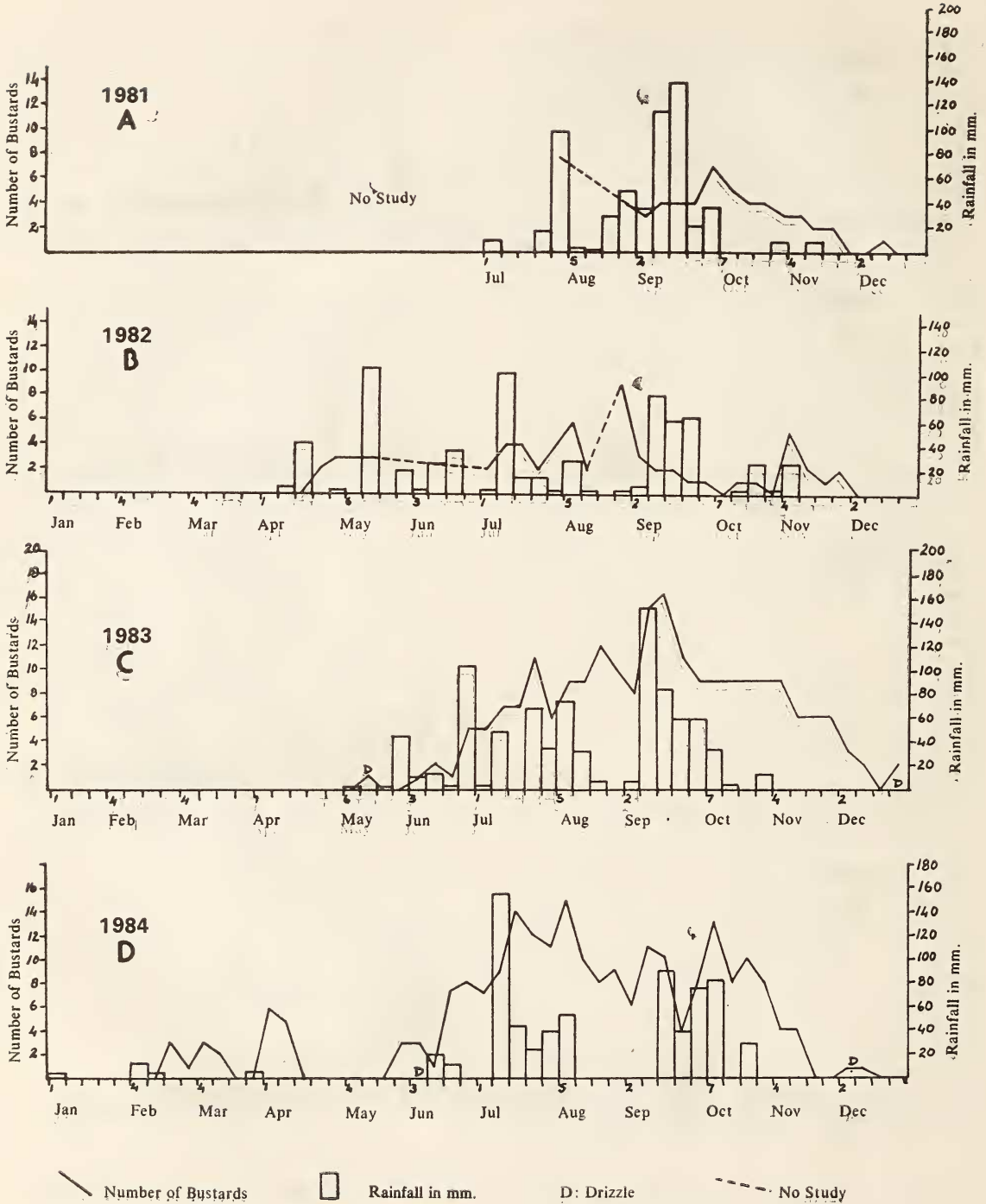


Fig. 2. Rainfall and movement of bustards at Nanaj.

and 12 May (fig. 2, C) and the first bustard, an adult cock, was sighted on 14 May when there was a slight drizzle. In June, one or two males were occasionally seen, either solitarily or together. A female was seen for two days in June. By the last week of June, the monsoon started in full force, resulting in the re-appearance of bustards. Due to sufficient and timely rains between July and November (fig. 2, C), seven to ten birds were seen almost daily. Many hens bred (Table 4) and were seen solitarily while the non-breeders moved in small groups (Table 2, C). The territorial cock was seen till the second week of December.

The maximum number of birds in 1983 was seen in the morning of 18 September while it was raining: twelve birds, mainly females, in small groups of 3-4 birds, one hen on the nest, and the territorial cock in the display area. The same evening, six males were seen foraging together. During another rainy day (24th September), eight males (seven in one flock) were observed in one plot, and six females in another plot.

1984: Three female bustards were seen outside our main study area in the third week of February after a few days of rain and cloudy weather. One was probably with a post-juvenile female chick.

Due to unseasonal showers in February and April, the GIB returned to Nanaj (fig. 2, D) but soon disappeared when it again became hot and dry. Till the monsoon started on 11 July, there was a constant movement of bustards depending upon the local weather conditions.

Heavy rains on 11 July brought six females and a young male. During another rainy day, nine females in one flock, three sub-adult

males and the territorial cock were seen. Unseasonal dry weather between 13 August and 16 September, greatly reduced the adult grasshopper population therefore many birds left the area. By October, except for the territorial cock and two females with a chick each, other birds were erratically seen. As expected, more birds were seen during rainy or cloudy days. For example, on 22 October, five birds (two adult cocks and three hens) were seen, but after the rains on 22nd night, ten birds were counted the next morning.

*Flock composition:* During the breeding season, the adult cock bustard remains solitary (Tables 1, 2, 3). Most of the sightings of two or three adult cocks in a flock were in the non-breeding months (e.g. April-May in 1982, June in 1984). During the breeding season, only the subadult males stay together. The most common male flock size was two. However, during a rainy day the males of an area sometimes congregate like females (see below). For example, seven males were seen together in September 1983 during a rainy day.

The adult cock tolerates a juvenile male, especially away from the display ground. This toleration was more markedly seen in 1982 and 1984, two bad years as far as breeding is concerned. For example, in August 1983 (Table 2, C) the territorial cock was always seen alone or near females but in August 1984 (Table 2, D) it occasionally tolerated a juvenile male.

In the non-breeding season, most of the hens live in flocks consisting of 2-10 birds (Table 2). A single female is rarely seen between January to June. With the onset of monsoon in July/August, the bustards come to Nanaj. The females arrive in group size

TABLE 1  
 NUMBER OF GROUPS (n) AND PERCENTAGES (%) OF BUSTARDS IN DIFFERENT MONTHS AT NANAJ  
 1981-A

\* No study.

Group Size	Jan*		Feb*		Mar.*		April*		May*		June*		July*		Aug.		Sept.		Oct.		Nov.		Dec.		
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
1	3	50																							
2	1	16.6																							
3	0	—																							
4	1	16.6																							
5	1	16.6																							
Total sightings	6																								
Mean group size	2.3																								

1982-B

1	0	—	5	45.4																						
2	1	100	3	27.2																						
3	0	—	3	27.2																						
4	0	—	0	—																						
5	0	—	0	—																						
6	0	—	0	—																						
7	0	—	0	—																						
Total sightings	1		11																							
Mean group size	2		1.8																							

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TABLE 1 (contd.)  
1983-C

Group Size	Jan		Feb.		March		April		May		June		July		Aug.		Sept.		Oct.		Nov.		Dec.	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
1	1	100	0	—	0	—	0	—	1	100	10	100	34	56.6	87	76.3	66	64	93	77.5	88	82.2	8	57.1
2	0	—	0	—	0	—	0	—	0	—	0	—	3	5	15	13.1	17	16.7	15	12.5	10	9.3	6	42.8
3	0	—	0	—	0	—	0	—	0	—	0	—	11	18.3	6	5.2	10	9.7	9	7.5	5	4.6	0	—
4	0	—	0	—	0	—	0	—	0	—	0	—	4	6.6	4	3.5	4	3.8	3	2.5	4	3.7	0	—
5	0	—	0	—	0	—	0	—	0	—	0	—	5	8.3	1	0.8	1	0.9	0	—	0	—	0	—
6	0	—	0	—	0	—	0	—	0	—	0	—	2	3.3	0	—	3	2.9	0	—	0	—	0	—
7	0	—	0	—	0	—	0	—	0	—	0	—	0	—	1	0.8	2	1.9	0	—	0	—	0	—
8	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—
9	0	—	0	—	0	—	0	—	0	—	0	—	1	1.6	0	—	0	—	0	—	0	—	0	—
Total sightings	1	10	10	60	114	103	120	107	14	14	10	60	114	103	120	107	14	14	10	60	114	103	120	107
Mean Group size	1	1	1	2.2	1.4	1.7	1.3	1.2	1.4	1.4	1	2.2	1.4	1.7	1.3	1.2	1.4	1.4	1.3	1.3	1.2	1.2	1.4	1.4

1984-D

1	3	60	7	50	3	21.4	0	—	0	—	22	62.8	33	51.5	68	57.1	70	56.9	70	61.9	34	79	2	66.6
2	2	40	7	50	7	50	0	—	0	—	3	8.5	4	6.2	25	21	38	30.8	23	20.3	5	11.6	1	33.3
3	0	—	0	—	3	21.4	0	—	0	—	4	11.4	10	15.6	7	5.8	7	5.6	9	7.9	3	6.9	0	—
4	0	—	0	—	0	—	0	—	0	—	3	8.5	2	3.1	5	4.2	7	5.6	9	7.9	1	2.3	0	—
5	0	—	0	—	1	7.1	0	—	0	—	0	—	2	3.1	7	5.8	1	0.8	2	1.7	0	—	0	—
6	0	—	0	—	0	—	0	—	0	—	3	8.5	3	4.6	4	3.3	0	—	0	—	0	—	0	—
7	0	—	0	—	0	—	0	—	0	—	0	—	1	1.5	1	0.8	0	—	0	—	0	—	0	—
8	0	—	0	—	0	—	0	—	0	—	0	—	2	3.1	0	—	0	—	0	—	0	—	0	—
9	0	—	0	—	0	—	0	—	0	—	0	—	5	7.8	1	0.8	0	—	0	—	0	—	0	—
10	0	—	0	—	0	—	0	—	0	—	0	—	2	3.1	1	0.8	0	—	0	—	0	—	0	—
Total sightings	5	14	14	14	14	14	0	0	0	0	35	64	119	123	113	113	43	43	113	113	43	43	3	3
Mean group size	1.4	1.5	1.5	2.2	—	—	—	—	—	—	2.0	3.0	2.8	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.3	1.3	1.3	1.3

TABLE 2  
 NUMBER OF SIGHTINGS OF MALE (♂); FEMALE (♀) AND MIXED (M) FLOCKS OF BUSTARDS AT NANAJ.  
 — Birds not in the area. \* No study  
 1981-A

Group Size	Jan.		Feb.		March		April		May		June		July		Aug.		Sept.		Oct.		Nov.		Dec.							
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀						
1	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	3	0	0	4	2	0	18	50	0	6	11	0	0	1	0
2																0	1	0	0	1	0	0	3	0	0	0	0	0	0	0
3																0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
4																0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
5																0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean group size																1	3.6		1	1.3		1.1	1	1	1	1	1	1	1	

Group Size	1982-B		♂		♀		M	
	♂	♀	♂	♀	♂	♀	♂	♀
1	—	—	—	—	—	—	—	—
2	1	1	0	0	21	0	0	18
3	0	0	0	0	2	1	1	2
4	0	0	0	0	0	0	3	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
Mean group size	2	2	1.8	1.3	2.5	1	2.7	1.1



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TABLE 2 (contd.)  
1983-C

Group Jan. Size	Feb.		March		April		May		June		July		Aug.		Sept.		Oct.		Nov.		Dec.									
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀								
1	—	—	—	—	—	—	1	0	0	8	2	0	33	1	0	41	46	0	28	38	0	44	49	0	34	54	0	1	7	0
2	—	—	—	—	—	—	0	0	0	0	0	0	0	3	0	0	15	0	4	13	0	1	14	0	0	10	0	0	6	0
3	—	—	—	—	—	—	0	0	0	0	0	0	0	11	0	0	6	0	2	8	0	0	9	0	0	5	0	0	0	0
4	—	—	—	—	—	—	0	0	0	0	0	0	0	4	0	0	4	0	0	4	0	0	3	0	0	4	0	0	0	0
5	—	—	—	—	—	—	0	0	0	0	0	0	0	5	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0
6	—	—	—	—	—	—	0	0	0	0	0	0	0	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
7	—	—	—	—	—	—	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
8	—	—	—	—	—	—	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	—	—	—	—	—	—	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean group size	1	1	1	1	1	1	1	1	1	1	1	1	1	1.6	7	1.4	2	1.5	1	1.4	1	1.4	1	1.4	1	1.4	1	1.4	1	1.4

1984-D

Group Jan. Size	Feb.		March		April		May		June		July		Aug.		Sept.		Oct.		Nov.		Dec.								
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀							
1	—	—	—	—	—	—	—	—	21	1	0	33	0	0	52	16	0	54	16	0	59	11	0	25	9	0	2	0	0
2	0	2	0	0	0	7	0	0	3	0	1	3	0	14	11	0	13	25	0	11	12	0	0	5	0	0	0	0	1
3	0	0	0	0	0	3	0	0	1	3	0	2	8	0	2	5	0	3	4	0	1	8	0	0	2	1	0	0	0
4	0	0	0	0	0	0	0	0	0	3	0	0	2	0	1	4	0	0	7	0	0	8	1	0	1	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	2	0	1	6	0	0	1	0	0	1	1	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean group size	1	1.5	1	1.5	1	1.5	1	2.5	1	3.5	1.1	5.5	1.3	3	1.2	2	1.1	2.4	4.5	1	1.7	3	1	1.7	3	1	2	1	1.4

TABLE 3

NUMBER OF SIGHTINGS, PERCENTAGES AND MEANS OF THE GIB AT NANAJ FROM 1981 TO 1984

Group Size	Year				Percentage			
	1981	1982	1983	1984	1981	1982	1983	1984
1	95	74	387	312	93.1	66	73.1	58.5
2	5	24	66	115	4.9	21.4	12.4	21.5
3	0	9	41	43	—	8	7.7	8
4	1	2	19	27	0.9	1.7	3.5	5
5	1	0	7	13	0.9	—	1.3	2.4
6	0	2	5	10	—	1.7	0.9	1.8
7	0	1	3	2	—	0.8	0.5	0.3
8	0	0	0	2	—	—	—	0.3
9	0	0	1	6	—	—	1.1	1.1
10	0	0	0	3	—	—	—	0.5
Mean	1.11	1.57	1.53	1.90				

Mean Group size of four years = 1.6 birds.

TABLE 4

NUMBER OF SIGHTINGS (n) OF FEMALE GROUPS DURING THE BREEDING SEASON (JULY-DECEMBER) AT NANAJ

Year	Solitary Female		In groups (2-10)		Breeding success (No. of eggs)	Total sightings of Females
	n	%	n	%		
1981*	64	90.1	7	9.8	5	71
1982	2	9.1	20	90.9	Nil	22
1983	192	59.1	133	40.9	15	325
1984	52	27.2	139	72.7	3	191

(\* August to December).

ranging from 2 to 10 birds (Table 2, C, D). Generally in any particular day all the females of an area are seen in one flock. As the breeding season progresses, one by one the females separate for nesting, thus sighting of solitary females between August and November becomes more common (Table 4). Only the juvenile females and non- or late-nesters remain together. As the chicks are fledged, the hens leave the area with their respective chick, thus departure of female bustards from Nanaj is

gradual. More solitary females (or with a chick) are seen during November/December (Table 2). Occasionally two hens each with about-to-be-fledged chick move together but this association is not permanent.

Female and male of the GIB are rarely seen together (Table 2, A-D). Most of the sightings of mixed flocks were of a post-juvenile male with its mother and other hens (e.g. August 1983, Table 2, C). Nevertheless, once or twice we did see adult male(s) with adult

female(s) (e.g. in May and July 1982) but this association was not permanent as in an all-female flock.

#### DISCUSSION

*Influence of rain on the movements of bustards:* Jerdon (1864) was the first observer to point out that the Great Indian Bustard occurs in large numbers in the rainy season in the Deccan plains. Davidson & Wenden (1878) also mentioned that "they are very much more common (in Deccan) during the rains and cold season than at other times". Hume and Marshall (1880) noted that in the Sirsa district it is "extremely abundant during the rainy season, when it breeds, whereas during the cold season, it is comparatively scarce". Fraser (1881) mentions seeing 80-100 bustards near Malegaon (Maharashtra) in 1840's. He adds "whether a flight of locusts or grasshoppers had alighted to attract this extraordinary flight of birds, or whether they assembled for migratory purposes, I cannot say....". Baker (1929) on the basis of existing literature and "numerous letters from observers and sportsmen" wrote that the GIB in many parts of India is most irregular in its movement, and that in other parts it is merely a seasonal visitor, either for the purpose of breeding or during the non-breeding season. Ali & Ripley (1969) have summarized its habit as resident and seasonally nomadic, dispersing widely in the monsoon with the creation of grasslands.

Our studies also reveal that the maximum number of bustards and the largest flocks at Nanaj were sighted during rainy days (weeks in the histograms, Figs. 1, 2), Even unseasonal showers in February and March 1984 bringing back a few birds. Dharmakumarsinhji

(1957) also noted that sudden and erratic rainfall during the winter in certain localities will attract a bird or two, who go there in the hope of finding better food. The Australian Bustard *Ardeotis australis* (Mathews 1913, White 1983) also has the habit of flocking to certain grasslands after the rains.

Tyabji (1952) reported seeing congregations of 200 or 300 bustards in 1923 between Ahmednagar and Manmad, and later (in 1926) of about 400 birds again near Manmad. Commenting on these unusual sightings, Dharmakumarsinhji (1953) opined that Tyabji might have confused the Eastern Common Crane *Grus grus lilfordi* with the bustard. The Editors (1953) of the JBNHS support Dharmakumarsinhji's opinion. Burton (1954) was also sceptical and wrote "In these days of the bustard in India having become a vanishing species it should be reported that during the years 1923-26, flocks of 200-400 bustards were seen". We think that in the olden days it would not have been unusual for the GIB to congregate at some prime grasslands in large numbers during certain seasons. The closely related Australian bustard is reported to have been seen in a loose group of 300 birds (Mathews 1913) and in 1897 even in a flock of one thousand (Barrett 1945).

Tyabji has not given the dates of sightings and the weather conditions to set the record straight. The Eastern Common Crane is a winter visitor, most abundant in the north-western parts of the subcontinent, straggling south to, the former Deccan down to c. 18°N lat. (Ali & Ripley 1969). Most of the bustard congregations were recorded by us during the monsoon, the time when the Crane is not present in the country. Therefore, there is no chance of confusing the two species if Tyabji

had seen the bustards during the monsoon.

The GIB still survives in Ahmednagar district and the topography is most suited for this species. Incidentally, the largest number of bustards (961) were shot in Ahmednagar district between 1808 and 1833 (Elliot 1880), so in the olden days, Ahmednagar along with Solapur seems to have been one of the strongholds of this species. Due to the erratic nature of the rainfall in these districts, it is not unlikely that 200-400 bustards had congregated in some locally good rainfall section of the region.

On 18 July 1984, while it was raining, we counted 35 bustards in a grassland of about 200 ha near Rollapadu village, Kurnool district of Andhra Pradesh. A thorough search in the surrounding agricultural fields could not reveal any more bustard, so obviously, most of the birds of that region had concentrated in that small grassland to feed on the abundant grasshoppers. Earlier to this sighting the GIB had been considered almost extinct in Andhra Pradesh and Pushp Kumar (1980) had reported that probably only 15 GIB were left in the State though "no census has been carried out". When 35 bustards could be seen in 1984 in a small area when the GIB has become much more uncommon, the sighting of 200-400 bustards, about sixty years ago in their main stronghold should not be considered so impossible. Moreover, Tyabji's comments that he had seen the bustards "not in a flock, but scattered 50 to 100 paces from each other", and that when one was shot, the birds flew "not in a flock but scattered all over the countryside" strongly supports his assertion that the birds were GIB, and not cranes. The Common and Demoiselle (*Anthro-*

*poides virgo*) cranes keep in large cohesive flocks and when disturbed generally fly off together noisily. On the contrary, the GIB are generally found in loose parties and when disturbed, scatter in different directions.

Precipitation determines the greening of vegetation and indirectly in the increase of insect populations on which the bustards normally feed. Recently Davies (1984) has shown that nomadism is an adaptation in response to desert conditions where finding adequate food in a particular place year by year is less predictable for some birds than in higher rainfall areas. Emus *Dromaius novaehollandiae* (Davies 1968, 1984) and sandgrouse (Thomas 1984) also move towards recent rainfall areas in search of food and for nesting.

The bustard is known to be a "rains-breeder", especially in the arid and semi-arid regions of its distribution. Dharmakumarsinhji (1954) states that, like the Lesser Florican *Sypheotides indica* the breeding season of the bustard is dependent on the rains. Regarding the breeding season of the bustards of Solapur Davidson & Wenden (1878) state "the birds come in, in the beginning of the rains to breed and leave, when the young are able to fly". Davidson and Wenden's above statement agrees with our findings. The GIB's arrival with the rains and dependence on adequate precipitation for breeding is not difficult to understand, as in semi-arid areas, animals and plants are almost completely dependent on rainfall (Tree 1972). And since the majority of birds breed at a time when food is most plentiful for the young (Thompson 1950, Skutch 1950, Moreau 1950, Lack 1950, 1968 and Perrins 1970) the bustards of Nanaj come and breed during the monsoon.

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*Flock composition:* Many workers (e.g. Gupta 1970, Neginhal 1980, Kapoor and Bhatia 1980, etc.) have reported seeing the GIB in pairs. On the contrary our studies reveal that pair formation as seen in geese, sarus, mynas, bulbuls etc., is not found in the GIB and they rarely live in pairs. A hen with her post-juvenile male young one is generally confused as a pair.

The male and the female of the GIB stay in their own flocks. Mixed flocks are rare (Table 2) and temporary. Even in a mixed flock, different sexes form their own sub-groups, except for the post-juvenile male which is strongly attached to its mother.

Though the sex ratio is not known in the GIB, apparently there are more females than males. Most of the larger group sizes (8-10) were of females and in all the four years, more females were sighted than males (Tables 1, 2).

The larger female groups break up into smaller units as the breeding season progresses and the females start nesting separately. As expected, solitary females were more commonly seen at Nanaj in good breeding years (i.e. 1981 and 1983) than in bad breeding years (i.e. 1982 and 1984) (Table 4).

The mean group size of female GIB is more than the mean group size of males (Table 2, A-D). Moreover, the mean group size of females also varies in different months and in different years depending on the breeding chronology. It should be noted that due to strict protection, the GIB population is increasing at Nanaj (and elsewhere in Solapur district), therefore, in addition to sighting of more birds in later years (fig. 2, C-D) the mean group size was also more in 1983 and 1984 compared to 1981-82.

Taking the total number of sightings and the total number of birds seen during these

sightings, the mean group size of four years comes to 1.6 birds. This is much below expectation. The mean group size of Blue Korhaan *Eupodotis caerulea* (Maclean *et al.* 1983) was 3.39 birds, and of Karoo Korhaan *E. vigorsii* (Viljoen 1983) was 2.35 birds. Maclean *et al.* (1983) think that this difference is probably because the Blue Korhaan inhabits a less severe environment and lays a clutch of two eggs (as opposed to one egg in the desert dwelling Karoo Korhaan). The GIB also lays one egg (Dharmakumarsinhji 1957, Ali & Ripley 1969) and the chick moves with the mother for about a year (this study). Even then we found the mean group size for all the four years of study to be less than two birds (Table 3). This can be explained by the fact that the birds were sighted mainly during the breeding season and the maximum sightings were of the solitary cock and the nesting hens resulting in bias in the data. A more detailed study of marked and/or radio-collared GIB throughout the year would perhaps indicate that the nomadic population of the GIB of the Deccan region live in a mean group size of more than two birds.

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